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CYCLIC CHANGES IN SOUTHERN-ITALIAN PRECIPITATION

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INTRODUCTION

Attention was recently drawn[a,b] to the possible role which short wave radiation may bear on water-nucleating properties of some compounds which are present in the atmosphere as aerosols. A recent study by PAVESI[c] has furthermore shown that paucity of very active nuclei in clouds may often lead to considerable supersaturation and thus inhibit the precipitation of the "potentialy available" atmospheric water. On the other hand, a possible contribution of water-nucleating systems to the water cycle on an extensive scale, has been stressed by KOMABAYASI & IKEBE[d] in a recent review.

An influence of the sun on the balance of precipitation which may go further than the plain heating-evaporation process, appears therefore possible. Thus it has been reported[e] that the atmospheric content of ozone follows a periodic variation with time in accordance with the solar cycle, and it is known on the other hand that the "southern oscillation" phenomenon appears to behave similarly (cf: (e)). While not going into the details of mechanisms involved, this paper has as its object the investigation of a possible overall correlation between a parameter representative of the sunspot cycle, and the annual precipitation pertinent to a zone of a somewhat restricted geographic region.

DATA AND RESULTS.

Data on annual volumes of precipitation in Sicily and Sardinia for the period 1926 - 1943 inclusive were taken from

publications of the Hydrographic Service of the Italian Ministry of Public Works.(f) Stations were chosen with care to obtain a reasonably uniform distribution around major mountainous systems, and were subdivided into 5 distinct categories of altitude, for which precipitation averages were computed; the number of stations considered and their grouping is given in Table 1.

The results obtained are expressed in "anomalies" (percentage ratios of an annual precipitation per altitude category, to the average annual precipitation value for the period studied); or in corresponding ratios of anomalies at higher levels, to the lowest level anomaly. Since a parallel study of data pertinent to the Italian mainland, which used a much larger number of stations than the one considered in this contribution, revealed no substantial correlation of precipitation values with such various geophysical occurences as are commonly thought to be dependent on some aspects of the solar activity, and since but a small correlation with average annual temperature values seemed to be detected, we limit ourselves here to regressions of anomaly values against the annual average Zürich sunspot number. This choice furthermore appears to offer the advantage of enabling an annual precipitation trend to be computed in advance, in accordance with the pattern outlined below, since the sunspot number can be computed fairly well for future years.

Linear correlation coefficients between annual anomalies and the sunspot number, are given in Fig. 1, as function of

TABLE 1.

	Number of Stations taken at levels:						Ave.Altitude of Station level(metres)				
Category Nº	0	I	II	III	IV	Tot.	0	I	II	III	IV
level(metres)	0-200	200-500	500-700	700-1000	>1000						
SICILY	34	37	49	18	4	142	102.4	376.1	595.3	875.4	1008.5
SARDINIA	42	42	35	15	-	134	63.0	332.8	585.7	751.5	-
TOTAL	76	79	84	33	4	276	80.6	353.1	591.3	819.1	1008.5

Distribution of stations in Sicily & Sardinia according to their altitude categories.

the phase with which the Zürich number was taken with respect to the year of precipitation. The regularity of the cyclic pattern obtained appears very good despite a relatively small number of stations used. Maximum correlation seems to follow the solar parameter by about 2 - 4 years, while the minimum lies at about +1 phase for the region studied. Even greater cyclic regularity is obtained between RATIOS of anomalies at a given level of altitude, to the lowest level anomaly - and the lag, as revealed by Fig.2. The maximum correlation lies at about + 1 year phase. If linear regression parameters between anomaly ratios and the sunspot number are computed and plotted against the average altitude of the higher level, fairly consistent linear trends are obtained, as shown in Fig. 3.

CONCLUDING REMARKS

Results similar to the above, can be obtained if a larger number of stations is taken and the analysis extended to the Italian Mainland. It was noticed however that small changes in phase of curves such as the ones given in Figs. 1 - 2, may be expected from region to region. The figures quoted indicate that a general trend of natural precipitation values over a suitable zone, may in some cases be easily estimated, if sufficient previous data on volumes of precipitation are available. This in turn may be useful in both the planning and monitoring of hydrologic enterprises in a zone where long-range estimation of water level fluctuations is required. The method can furthermore be

profitably applied in evaluations of long-term cloud seeding campaigns where base values of anomaly trends are sometimes necessary for a correct estimation of an induced precipitation.

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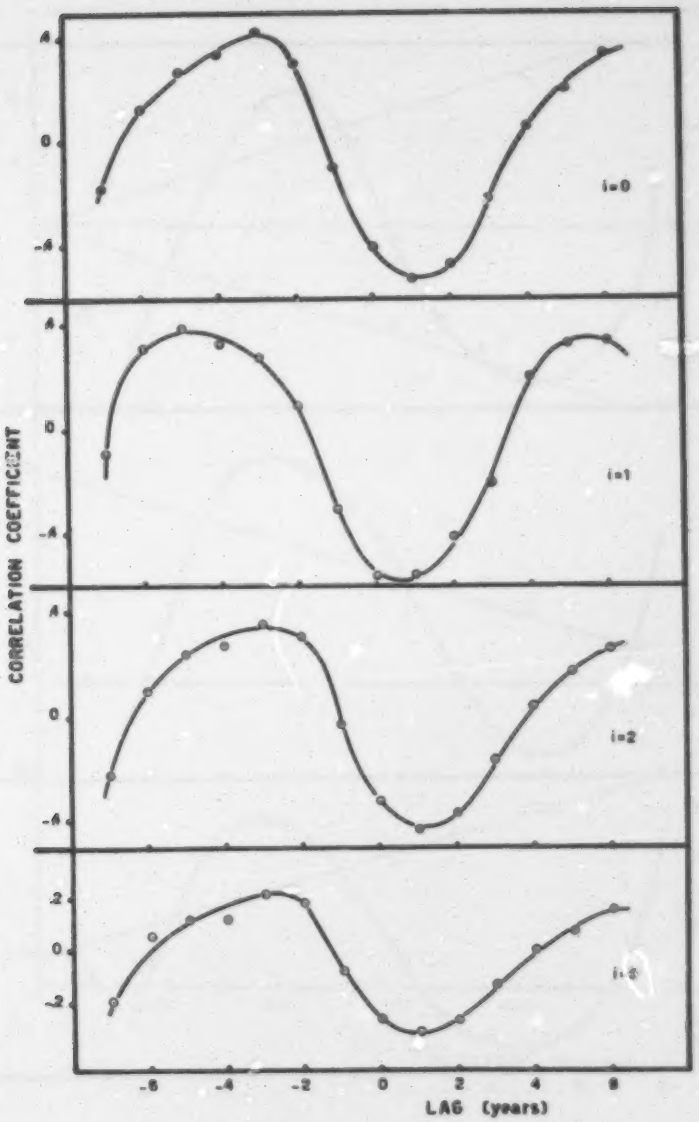

Fig. 1 - Plot of linear correlation coefficients between annual anomalies at the "i" level altitude, and the relative Zürich annual average sunspot number, with the phase, in years, by which the sunspot numbers lagged with respect to the year of anomaly computation. Values for Sicily alone were used in calculations.

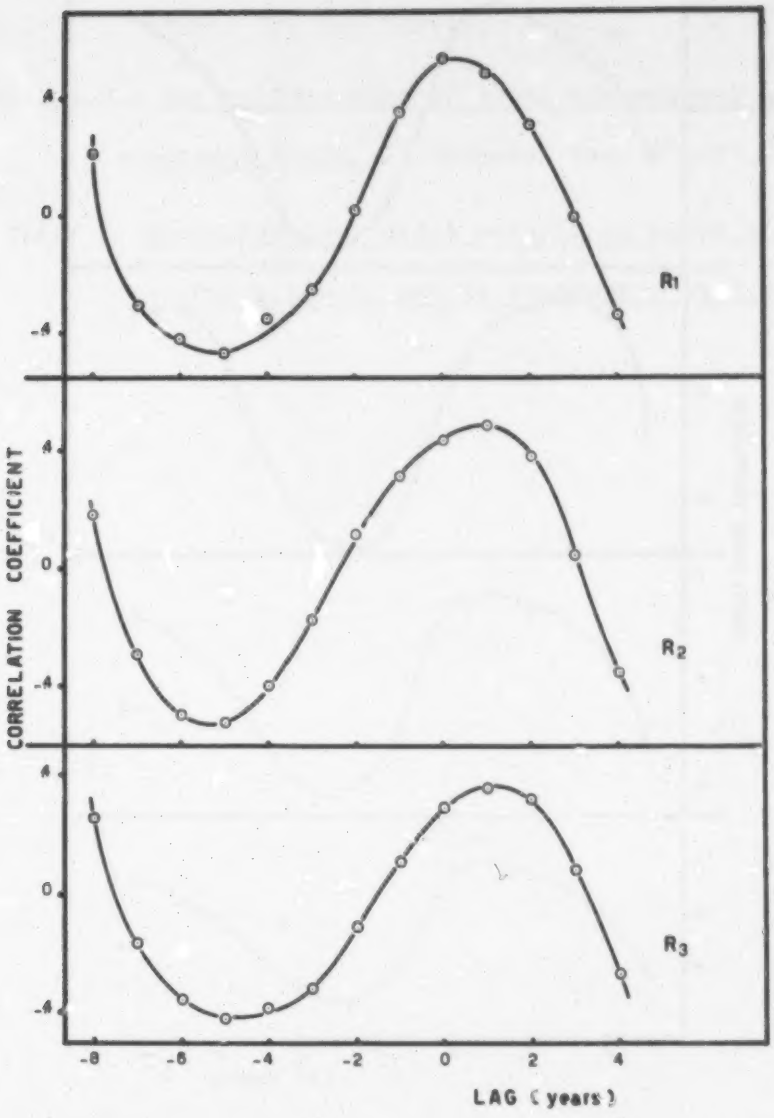

Fig. 2 - Change of linear correlation coefficients between ratios of anomalies at altitude level "i", to anomalies at level zero, and the relative Zürich annual average sunspot number, with the phase, in years, by which the sunspot numbers lagged with respect to the year of anomaly computations. Values for Sardinia alone were used in calculations.

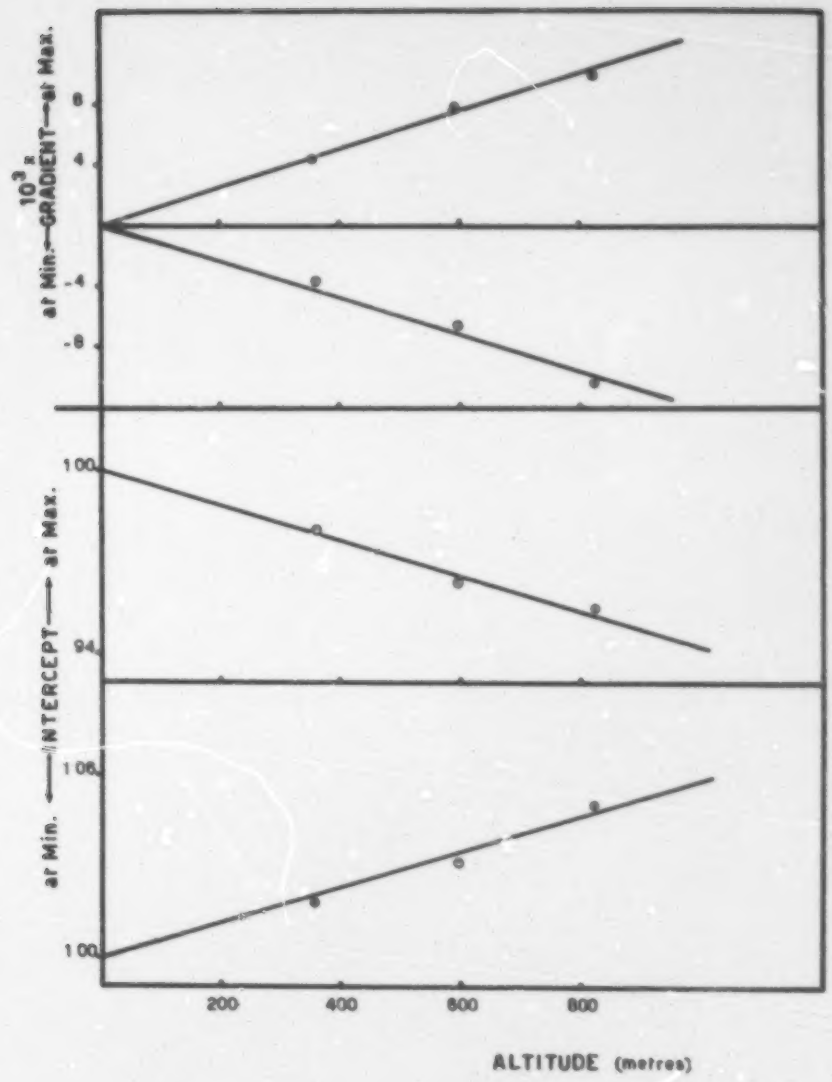

Fig. 3 - Plots of linear regression parameters computed at phase values corresponding to lag of +1 and -4 respectively (approximate maxima and minima for a cumulative diagram of the type of Fig. 2) and pertinent to the system: $Anom_i/Anom_o$ vs. Zürich annual relative sunspot number - against average altitudes of station categories studied. All values of both large Italian isles were used for this diagram. Tentative regression lines are forced through zero and unity origin values, respectively.

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